Reducing Energy Consumption at LLNL's Supercomputer Facility

Lawrence Livermore National Laboratory is working to reduce its energy consumption by at least 30 percent per unit area by 2015, relative to its consumption rates in 2003. The Laboratory is committed to meeting this challenge through innovative design, re-engineered maintenance and operations practices, enhanced performance requirements for operational equipment and systems, and alternative financing.

In the Lab's Computation Directorate, facilities managers have accomplished significant energy savings within the organization's Terascale Simulation Facility (TSF), which houses the Lab's supercomputers. The Directorate was able to exceed its fiscal year 2008 incremental target of 9 percent reduction in energy consumption relative to 2003. At the same time, this has allowed the organization to reduce its operating costs.

The supercomputers housed in the Terascale Simulation Facility produce a lot of heat during operation and must be kept cool to keep them from overheating. This is accomplished through air-conditioning and circulating chilled water. Seeking opportunities to save energy, TSF facilities managers:

- Raised the thermostat for the air-conditioning from 53.4 degrees F to 60.4 degrees F.
- Raised the temperature of the chilled water from 43 degrees F to 50 degrees F.

Raising these temperatures will save nearly 26,000 megawatt hours of electricity annually, with no measurable increase in computer component failure rates.

TSF staff also discovered that cool air was leaking out of the computer rooms at a rate of approximately 450,000 cubic feet per minute through closed louvers set into perforated and grated tiles. The tiles were leaking at a rate of 10 percent while in the closed position, which was much higher than their manufacturer's published data. Facility staff replaced approximately 50 percent of the tiles with solid tiles, which allowed them to shut off two 80,000 cubic-feet-per-minute air handlers, thereby saving an additional 1,000 megawatt hours of electricity.

The Terascale Simulation Facility is a fairly energy-efficient building, especially considering the massive architectural, electrical and mechanical systems it contains. Power usage effectiveness (PUE) is one industry standard measure that is often used to quantify and compare the energy efficiency of such data centers. PUE can range from 1.0 to infinity, with the idea value being 1.0, signifying 100 percent efficiency. TSF's PUE is 1.34, based on the original facility design, plus the improvements mentioned above. In comparison, industry-wide studies to date indicate that most data centers have PUE values ranging from 1.3 to 3.0.

TSF managers are studying whether they can further increase air-conditioning and chilled water temperatures without jeopardizing the computer equipment, thereby realizing additional energy savings.

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